SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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LANL MASTER SPECIFICATION

When editing to suit project, author shall add job-specific requirements and delete only those portions that in no way apply to the activity (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the ESM Electrical POC.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Delete information within “stars” during editing.

Specification developed for ML-3 projects. For ML-1 / ML-2, additional requirements and QA reviews are required.

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PART 1 GENERAL

1.1 SECTION INCLUDES

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Edit the following articles to match Project requirements; delete articles that are not needed.

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A. Main Grounding Electrode System (Lightning Protection System grounding is specified in Section 26 4100.)

B. Circuit and System Grounding

C. Enclosure and Equipment Grounding System

D. Isolated Ground System

E. Signal Reference Grid

F. Static Electricity Grounding and Bonding

1.2 LANL PERFORMED WORK

A. None

1.3 SUBMITTALS

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Edit the following articles to match Project requirements; delete articles that are not needed. Include submittals only to the extent required to assure quality for the particular project.

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A. Submit the following in accordance with Section 01 3300 Submittal Procedures:

1. Catalog Data: Submit catalog data for grounding conductors, grounding clamps, grounding bushings, grounding plates, grounding bars, chemical ground rods, exothermic weld materials, compression grounding connector materials, static grounding materials, and signal reference grid materials.

2. Shop Drawings: Submit shop drawings for signal reference grid fabrication and installation.

3. Project Record Documents: Submit project record documents to include specified certifications and field test reports of installed grounding systems.

1.4 REGULATORY REQUIREMENTS

A. Comply with the National Electrical Code (NEC) for components and installation.

B. Provide products that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for the application and environment in which installed.

1.5 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products according to NECA 1 Standard Practices for Good Workmanship in Electrical Construction.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, Substitution Procedures.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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2.2 GROUND ELECTRODE CABLE

A. Provide bare stranded, soft temper copper cable that conforms to ASTM B8 Standard Specification for Concentric-Lay Stranded Copper Conductors.

2.3 CHEMICAL GROUND ROD

A. Provide NRTL listed chemical ground rod(s) as shown on the Drawings.

B. Furnish chemical ground rods fabricated from Type K copper tubing approximately 10 feet long, 2 inches in diameter and containing a hygroscopic electrolyte material.

C. Furnish each chemical ground rod with a 24 inch long 4/0 AWG copper pigtail, a protective cover box, and sufficient ground ground-enhancing backfill material for installation in a 6 inch augered hole.

D. Manufacturers: Lyncole Industries Inc., LEC Inc., Superior Grounding Systems Inc.

2.4 GROUND ELECTRODE BACKFILL MATERIAL

A. Provide ground enhancement backfill material for ground rods and cable type electrodes.

B. Field-mixed backfill material shall consist of approximately 75 percent gypsum (calcium sulfate), 20 percent bentonite clay, and 5 percent sodium sulfate.

C. Commercial backfill material, when at 300% moisture content ((weight of water/weight of material)x 100), shall have a resistivity of approximately 250 ohm-cm at 30% solids density and a pH of 8 to 10.

D. Manufacturers: Lyncole “Lynconite”, LEC Inc. “GAF”, Superior Grounding Systems “Electro-Fill”

2.5 EQUIPMENT GROUNDING CONDUCTORS

A. Provide NRTL-listed THHN/THWN insulated copper wire.

B. Use solid grounding conductors 10 AWG and smaller where not subject to vibration or repeated flexing.

C. Use stranded grounding conductors for 8 AWG and larger.

D. Use stranded grounding conductors where subject to vibration or repeated flexing. Use stranded grounding conductors in flexible conduit at motor connections.

E. Color code grounding conductors as follows:

1. Equipment ground:

    a. Conductors 6 AWG and smaller: Green colored insulation.

    b. Conductors 4 AWG and larger: Green colored insulation or black colored insulation with 3/4 inch wide band of water and oil-resistant green plastic adhesive tape.

2. Isolated ground:

    a. Conductors 6 AWG and smaller: Green colored insulation with continuous yellow stripe.

b. Conductors 4 AWG and larger: Green colored insulation with continuous yellow stripe or black colored insulation with 3/4 inch wide bands of water and oil-resistant green and yellow plastic adhesive tape.

2.6 GROUND BAR

A. Provide ground bar, 12 inches long or greater length as indicated on the Drawings, fabricated from 1/4 inch thick, 4 inch wide copper stock with (1” + 3/4") x 2" bolt hole pattern to accept NEMA standard lugs. Mount ground bar on 2700 volt standoff insulators.

B. Provide 25 ft 4/0 AWG copper pigtail exothermically welded to the ground bar.

C. Manufacturer: Harger “GBIT”

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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2.7 GROUND PLATES

A. Provide ground plates designed for flush mounting in concrete structures.

B. Furnish copper alloy castings with four 1/2” x 13 threaded holes at 1.75" x 1.75" NEMA spacing and a welding stud or compression connection suitable for 2 AWG to 250 kcmil copper conductor.

C. Furnish NRTL-listed ground plates that are suitable for direct burial and have been tested successfully according to the requirements of IEEE Std. 837 IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

D. Manufacturer: Burndy “YGF”

2.8 PIPE GROUNDING CONNECTORS

A. Provide NRTL-listed copper-alloy connectors for making cable to pipe connections.

B. Manufacturer: O-Z/Gedney “ABG” or “CG”..

2.9 CONDUIT GROUNDING BUSHINGS

A. Provide NRTL-listed, galvanized malleable iron, 150 C rated insulated throat grounding bushings with lay-in type ground cable lugs.

B. Manufacturers: O-Z/Gedney Type “BLG”

2.10 EXOTHERMIC WELD GROUNDING CONNECTIONS

A. Provide molds and welding material for making exothermic weld connections.

B. In interior locations and in vaults, use low smoke emission type welding material.

C. Match mold and weld material to material types, shapes and sizes to be joined.

D. Manufacturer: ERICO Cadweld

2.11 COMPRESSION GROUNDING CONNECTIONS

A. Provide wrought copper connectors, terminals, taps, and splices for making irreversible compression grounding connections.

B. Furnish NRTL-listed grounding connectors that are suitable for direct burial and have been tested successfully according to the requirements of IEEE Std. 837 IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

C. Provide connector manufacturer's hydraulic compression tools and dies that match the connectors.

D. Match connector and die size to material shapes and conductor sizes to be joined.

E. Use two-hole heavy-duty compression lugs for bolted connections to ground bars, ground plates, and equipment ground pads.

F. Manufacturer: Burndy "Hyground"

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Edit the following Article to match Project requirements. Delete if not applicable to Project. Refer to Section D5020 in Chapter 7 of the LANL Engineering Standards Manual for design requirements

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2.12 SIGNAL REFERENCE GRID (SRG)

A. Furnish signal reference grid (SRG) as indicated on the Drawings.

B. Provide a pre-fabricated grid of 2 inch wide by 26 gage copper strips on two foot centers with all crossover connections factory welded.

C. Provide low impedance risers consisting of 2 inch wide by 26 gage copper strips for connecting equipment to the signal reference grid.

D. Manufacturers: ERICO Cadweld, Harger

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Edit the following Article to match Project requirements. Delete if not applicable to Project. Refer to Section D5020 in Chapter 7 of the LANL Engineering Standards Manual for static electricity grounding and bonding design requirements.
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2.13 STATIC ELECTRICITY GROUNDING AND BONDING

A. Furnish static electricity grounding and bonding material as indicated on the Drawings and as required for a complete installation.

B. Provide static ground bus complete with clamps, connectors, and mounting hardware.

1. Ground bus cable: 1/0 AWG bare stranded, soft temper copper cable that conforms to ASTM B8 Standard Specification for Concentric-Lay Stranded Copper Conductors.

2. Connectors: Copper compression ring tongue terminals. Provide connector manufacturer's compression tools and dies that match the connectors. Manufacturer: Burndy YAV-L.

3. Cable holders: Preformed copper support loops, 5/8 inch wide. Manufacturer: Thompson Lighting Protection No. 166.

C. Provide retractable static grounding reels with an enclosed cable drum and [20] [50] feet of 3/32 inch galvanized cable having a spring compression grounding clamp. Manufacturer: Stewart R. Browne Manufacturing type [R-20] [R-50].

D. Provide spring compression grounding clamps having a plier type cast aluminum body and two stainless steel contact points. Manufacturer: Stewart R. Browne Manufacturing type REB2960.

E. Provide cast bronze clamps for static bonding of metal pipes. Manufacturer: Stewart R. Browne Manufacturing JR150 series.

F. Provide cast bronze or galvanized steel C-clamps for making semi-permanent connections to drums and containers. Manufacturer: Stewart R. Browne Manufacturing type EP.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that work of other trades likely to damage grounding and bonding material has been completed.

B. Verify that field measurements are as shown on Drawings.

C. Electrode locations and grounding cable routing shown on Drawings are approximate unless dimensioned.

1. Install electrodes and route cable as required meeting project conditions.

2. Where electrode location or cable routing is not shown, and destination only is indicated, determine exact locations, routing, and lengths required to meet project conditions.

3.2 PREPARATION

A. Examine equipment and building finishes that are to receive grounding and bonding material for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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3.3 EXISTING WORK

A. Remove exposed abandoned grounding and bonding material, including that abandoned above accessible ceiling finishes. Patch surfaces where grounding and bonding materials are removed.

B. Disconnect abandoned grounding and bonding systems and remove.

C. Provide access to existing grounding and bonding connections remaining active and requiring access. Modify installation or install access panel.

D. Extend existing grounding and bonding systems using materials and methods specified.

3.4 GENERAL

A. Comply with the requirements of the NEC, this Section and the Drawings.

B. Install grounding and bonding material according to manufacturer's instructions. Have the manufacturer’s installation instructions available at the construction site.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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C. Do not use the grounding systems specified in this section for lightning protection grounding. A separate lightning protection grounding system is specified in Section [13100] [13101]. Bond the lightning protection ground to the main electrode system at the service entrance ground bar.

D. Use the following connection methods unless otherwise specified or indicated on the Drawings:

1. Use exothermic weld grounding connections for underground or concealed connections of dissimilar materials.

2. Use exothermic weld or compression grounding connections for underground or concealed connections of like materials.

3. Use exothermic weld, compression, or bolted grounding connections for accessible connections.

4. Make bolted connections using bolts, nuts, flat washers, and toothed lock washers suitable for the connector and the installation environment; acceptable materials include high strength silicon bronze and 18-8 alloy stainless steel.

5. Make irreversible bolted connections using 18-8 alloy stainless steel tamper-resistant bolts and tamper-resistant nuts along with flat washers, and toothed lock washers. Tamper-resistant nuts and bolts must resist loosening with common tools; acceptable tamper-resistant fasteners include penta-head, break-away, and oval designs.

E. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B. Use a calibrated torque wrench.

F. Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Follow connector manufacturer’s installation instructions and use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed.

G. Install exothermic welds in accordance with manufacturer's instructions and recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

H. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.

2. Make connections with clean bare metal at points of contact.

3. Make aluminum to steel connections with stainless steel separators and mechanical clamps.

4. Make aluminum to galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections involving dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

I. Comply with requirements in Section 26 0529. Hanger and Supports for Electrical Systems.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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3.5 MAIN GROUNDING ELECTRODE SYSTEM

A. Concrete Encased Electrode: Where available, use the building concrete grade beam or strip footing to make a concrete encased main grounding electrode; use either copper ground cable or reinforcing steel as follows:

1. Install a continuous ground cable in the bottom one-third of the grade beam around the entire perimeter of the building. Use ground cable as indicated on the Drawings, not smaller than the grounding electrode cable required by the NEC, and not smaller than 4 AWG. Space cable from the bottom and sides of the grade beam so it has at least 2 inches of concrete coverage.

2. Make one or more reinforcing bars located in the bottom one-third of the footing, electrically continuous around the entire perimeter of the building. Use galvanized or uncoated reinforcing bars not smaller than the following sizes based on the total length of the interconnected and paralleled reinforcing bars:

Total length of reinforcing bars:	Minimum reinforcing bar size:
112 ft	1-3/8” (#11 bar)
150 ft	1” (#8 bar)
192 ft	3/4” (#6 bar)
223 ft	5/8” (#5 bar)
268 ft	1/2” (#4 bar)

   Bond the reinforcing bars together using bare copper ground cable jumpers that are either exothermically welded to the reinforcing bars or connected using hydraulically compressed tap connectors. Use jumpers compatible with the tap fitting that are not smaller than the grounding electrode cable required by the NEC and not smaller than 4 AWG.

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Use the following Article only it is not possible to install a concrete encased electrode or if the main grounding electrode must be supplemented. Delete if not applicable to Project.
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B. Supplemental Electrodes: Install one or more of the following supplemental grounding electrodes to obtain the required ground resistance or to establish a main grounding electrode that is separate from the lightning protection ground.

1. Install one or more chemical ground rods located 5 ft outside the building perimeter and at least 6 ft from any lightning protection grounding. Install ground rods in 6 inch diameter augered holes with at least 10 ft separation between rods. Backfill each hole with a slurry of ground electrode backfill material in accordance with the chemical ground rod manufacturer's instructions. Install protective cover box, suitable for the traffic at the location, over each electrode.

2. Install a bare copper ground cable not smaller than the grounding electrode cable required by the NEC and not smaller than 2 AWG, not less than 20 ft long, buried not less than 30 inches deep adjacent to the building foundation. Encase the electrode in a 2 inch envelope of ground electrode backfill material slurry.

3. Install a bare copper ground cable not smaller than the grounding electrode cable required by the NEC and not smaller than 4 AWG at least 20 ft long in the concrete envelope for the building electrical service conduits. Position ground cable in concrete to provide not less than 2 inches cover on all sides.

C. Main Ground Electrode Ground Bar:

1. Install a main electrode ground bar in an accessible location in the main electrical room adjacent to the service entrance equipment.

2. Make an irreversible connection between the main electrode ground bar and the main grounding electrode conductor; use exothermic weld connection or compression grounding lug with tamper-resistant fasteners.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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3. Main ground electrode ground bar extensions may be established at additional locations by installing ground bars or ground plates connected to the main electrode ground bar using 4/0 AWG insulated ground conductor with an irreversible connection to each ground bar.

4. Connections to the main ground electrode ground bar [or extensions] will be considered as connections directly to the main ground electrode.

D. Bond exterior underground metal fire protection and potable water service pipes to the main ground electrode bar; use pipe grounding fittings and ground cable as indicated on the Drawings, or not smaller than the grounding electrode cable required by the NEC and not smaller than 4 AWG. Make bond to each water pipe at an accessible location within 5 ft of where it enters the structure. Comply with NEC requirements for bonding around water meters and insulating joints.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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E. Bond the nearest building perimeter structural steel column or effectively grounded metal structure to the main ground electrode ground bar; use ground cable as indicated on the Drawings, or not smaller than the grounding electrode cable required by the NEC and not smaller than 4 AWG.

F. Bond each interior metal piping system to the main ground electrode bar; use pipe grounding fittings and ground cable as indicated on the Drawings, or not smaller than the grounding electrode cable required by the NEC and not smaller than 4 AWG. Make bond to each pipe at an accessible location.

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Edit the following Article to match Project requirements. Use this paragraph only if there are structural steel columns. Do not use for structural metal stud or reinforced concrete systems. Delete if not applicable to Project.
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G. Bond each building perimeter structural steel column to the main grounding electrode use ground cable as indicated on the Drawings, or not smaller than the grounding electrode cable required by the NEC and not smaller than 4 AWG.

H. Label each conductor connected to the main ground electrode ground bar or main ground electrode ground bar extensions. Refer to Section 26 0553, Electrical Acceptance Testing.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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3.6 CIRCUIT AND SYSTEM GROUNDING

A. Connect the service entrance equipment ground bus to the main electrode ground bar; use ground cable as indicated on the Drawings, or not smaller than the grounding electrode conductor required by the NEC and not smaller than 4 AWG.

B. In the service entrance equipment, connect the neutral bus to the ground bus using a bonding jumper not smaller than the grounding electrode conductor required by the NEC; do not use a bonding screw for this purpose. Make no other neutral-to-ground connections on the load side of the service entrance disconnect.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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C. Separately Derived Systems:

1. Connect ground bus of first disconnecting means for separately derived systems (e.g. dry type transformers, power distribution units, generators, and uninterruptible power supplies) in the vicinity of the main electrical equipment room to the main electrode ground bar; use grounding conductor sized as shown on the Drawings or as required by the NEC.

2. Connect ground bus of first disconnecting means for separately derived systems that are remote from the main electrical room to the nearest effectively grounded building structural steel column and the nearest effectively grounded metal water pipe; use grounding conductor sized as shown on the Drawings or as required by the NEC. Make connections at accessible locations.

3. Connect ground bus of first disconnecting means for separately derived systems that are remote from the main electrical room to an extension of the main electrode ground bar if there is neither a nearby effectively grounded building structural steel column nor an effectively grounded metal water pipe; use grounding conductor sized as shown on the Drawings or as required by the NEC.

4. At the first system overcurrent device or disconnecting means, connect the neutral bus to the ground bus using a bonding jumper sized as required by the NEC; do not use a bonding screw for this purpose. Make no other neutral-to-ground connections on the load side of the separately derived system disconnect.

3.7 ENCLOSURE AND EQUIPMENT GROUNDING

A. Provide permanent and effective equipment, enclosure, and raceway grounding in accordance with NEC requirements and as further specified or shown on the Drawings.

B. Provide an equipment ground bar, separate from any neutral bar, in all switchgear, switchboards, panelboards, transformers, motor control centers, starters, disconnect switches, cabinets, etc., for grounding the enclosure and for connecting other equipment and raceway ground conductors. Make connections to the ground bar using mechanical lugs or compression lugs.

C. Make connections and couplings on metallic conduit systems wrench tight.

D. Bonding Bushings:

1. Install bonding bushings on metallic conduit containing circuits rated 100 amperes and higher.

2. Install bonding bushings on metallic conduits entering enclosures through concentric, eccentric or oversize knockouts.

3. Install bonding bushings on metallic conduits that terminate to a metallic enclosure without effective electrical connection such as locknuts or threaded bushings.

4. Bond conduit bonding bushing lug to the equipment ground bar or ground lug in switchgear, panelboards, transformers, motor control centers, starters, disconnect switches, cabinets, etc. Size bonding jumpers in accordance with the NEC.

E. Provide an insulated equipment grounding conductor for each feeder and branch circuit.

1. Install the grounding conductor within the common conduit or raceway with the related phase and neutral conductors and connect to the grounding terminal or grounding bus in each box or cabinet.

2. Size equipment ground conductor in accordance with the NEC or as shown on the Drawings.

F. In each 15 or 20 ampere branch circuit outlet box and junction box, install a green colored washer head grounding screw with a 12 AWG equipment grounding conductor pigtail.

G. Connect receptacle grounding terminals to the equipment ground system using minimum 12 AWG equipment grounding conductor. Do not use a "self-grounding" receptacle strap as the only equipment grounding path.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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H. Bond raceways served from cable tray using conduit clamps or grounding bushings that are NRTL approved for the purpose. Refer to Section 26 0536, Cable Trays for Electrical Systems..

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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I. Install an equipment grounding conductor in each cable tray; size conductor per the NEC, but not smaller than 6 AWG. Bond grounding conductor to each cable tray section using UL Listed cable tray ground clamps. Connect grounding conductor to ground bus of each enclosure or equipment item served by the cable tray. Refer to Section 26 0536, Cable Trays for Electrical Systems.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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J. Provide busways with a separate, internal equipment ground bus bar. Install separate insulated equipment ground conductor from the ground bus in the switchgear, switchboard, or distribution panel to the equipment ground bar terminal on busway. Size conductor in accordance with the NEC.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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3.8 ISOLATED GROUND SYSTEM

A. Install an isolated ground system as shown on the Drawings to serve computer and laboratory instrument outlets.

B. In addition to the equipment ground bar, provide a separate, insulated, isolated copper ground bar in panelboards and switchboards supplying isolated ground circuits.

C. Run the isolated grounding conductor together with the phase, neutral, and equipment grounding conductors in isolated ground system feeder and branch circuit conduits.

D. Make the isolated ground conductor the same size as the associated phase conductors.

E. At the first isolated ground system phase conductor overcurrent device or disconnecting means, bond the isolated ground bus to the equipment ground bus. Make no other isolated ground to equipment ground connections on the load side of the separately derived system disconnect.

F. Connect the isolated ground conductors to the isolated ground bars in switchboards and panelboards and to the isolated ground terminals at receptacles and equipment.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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3.9 COMMUNICATION SYSTEM GROUNDING

A. Refer to Section 27 1000, Structured Cabling.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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3.10 UNDERGROUND DUCTBANK SYSTEM GROUNDING

A. Refer to Section 33 7119, Electrical Underground Ducts and Manholes.

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Edit the following Article to match Project requirements. Delete if not applicable to Project. Refer to Section D5020 in Chapter 7 of the LANL Engineering Standards Manual for signal reference grid design requirements.
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3.11 SIGNAL REFERENCE GRID

A. Install a signal reference grid (SRG) on the concrete subfloor under raised computer flooring as indicated on the Drawings. Join pre-fabricated grid sections by exothermic welding. Position copper strip so sharp burrs on edge of strip face down.

B. Bond structure, conduits, water pipes, ducts, etc., entering the computer room to the SRG. Bond to the nearest intersecting point of SRG using 6 AWG grounding conductor.

C. Bond computer equipment to the SRG using low impedance riser (LIR).

1. Do not connect LIR to the SRG strip closest to the outside edges.

2. Cut LIR to the shortest possible length.

3. If length of LIR exceeds 24 inches, use two parallel LIR's. Make the second LIR 20% to 40% longer than the first and connect to equipment at opposite corners.

D. Bond power distribution units and power distribution panelboards to the SRG using LIR.

E. Bond every sixth raised floor pedestal in each direction to the nearest intersecting point of the SRG using 6 AWG grounding conductor. Keep conductors as short as possible

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Edit the following Article to match Project requirements. Delete if not applicable to Project. Refer to Section D5020 in Chapter 7 of the LANL Engineering Standards Manual for static electricity grounding and bonding design requirements.
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3.12 STATIC ELECTRICITY GROUNDING AND BONDING

A. Install static electricity grounding and bonding material as indicated on the Drawings.

B. Comply with the NEC and NFPA 77 Recommended Practices on Static Electricity.

C. Install ground bus cable from the [main electrode ground bar or extension] [effectively grounded building structural steel] to the static electricity grounding and bonding locations indicated on the Drawings.

D. Support exposed ground bus cable with cable holders installed at intervals not exceeding 24 inches.

E. Make connections to and between ground bus cable using compression connectors, nuts, bolts, flat washers, and lock washers. Install compression connectors using tools and compression dies recommended by the connector manufacturer.

F. Install static grounding cable reels at locations indicated on the Drawings; coordinate location with luminaires, equipment, piping, and ductwork.

G. Install pipe clamps and C-clamps to bond pipes, drums, and tanks in the static electricity control areas.

3.13 FIELD QUALITY CONTROL

A. General: Perform on-site verification, certification and acceptance testing of the grounding installation during construction. Verification and testing will be witnessed by University designated representatives.

B. Notify the Contract Administrator ten (10) working days in advance of the expected completion of a grounding system installation. Verification and testing can be scheduled in parts or by area depending on the system and construction schedule.

C. Before work is concealed verify and certify that the following grounding installations have been made correctly:

1. The building grounding electrode system. This includes the bonding of the foundation reinforcing bars, bonding of the structural steel columns, and bonding of other metallic systems and other grounding electrode systems.

2. Ground plates and grounding bars.

3. All other underground grounding installations.

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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4. Signal reference grid (SRG) before the raised flooring is installed.

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Edit the following Article and Section 26 0813, Electrical Acceptance Testing, to match Project requirements. Delete if not applicable to Project.
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D. Acceptance Testing: Perform acceptance testing and submit written reports to the Contract Administrator in accordance with the requirements of Section 26 0813, Electrical Acceptance Testing. Tests will be witnessed by designated University representatives.

1. Perform ground-impedance measurements using the "fall-of-potential" method in accordance with IEEE 81 Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System. Use instrumentation specifically designed for ground impedance testing. Provide sufficient spacing of test electrodes so that the plotted curves flatten in the 62% area of the distance between the item under test and the current electrode. When sufficient spacing of electrodes is impractical for the "fall-of-potential" method, perform ground-impedance measurements using either the "intersecting curves method" or the "slope method", referenced in IEEE Std. 81. Investigate and correct ground resistances that exceed the following values:

a. Service rated 50 kVA or less: as required by the NEC

b. Service rated more than 50 kVA but less than 2500 kVA: 5 Ohms

c. Service rated 2500 kVA or greater: 1 Ohm

2. Test equipment ground resistances for the following items. Measure resistance between the equipment item and the Main Ground Electrode Ground Bar. Use the "two-point method" of IEEE Std. 81. Investigate and correct equipment ground resistances that exceed 0.5 ohm.

a. Transformers

b. Switchgear and Switchboards

c. Panelboards

d. Generators

e. Motor Control Centers

f. Motors larger than 1 HP

g. UPS Systems

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Edit the following Article to match Project requirements. Delete if not applicable to Project.
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E. Test static electricity bonding and grounding system resistances. Measure resistance between the static protection area ground bus and the Main Ground Electrode Ground Bar. Use the "two-point method" of IEEE Std. 81. Investigate and correct equipment ground resistances that exceed 10 ohms.

F. Prepare test reports, certified by the testing organization, of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe any measures taken to improve test results.

END OF SECTION

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Do not delete the following reference information.
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FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 0526 Rev. 0, dated January 6, 2006.